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(71) Applicant *(for all designated States except US)*: ADVANCED LIGHTING SYSTEMS (SCOTLAND) LIMITED [GB/GB]; 1-3 Hillside Street, Edinburgh EH7 5HD (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)* : MUNRO, Neil, Lennox [GB/GB]; Mc PHAIL, John [GB/GB]; 1-3 Hillside Street, Edinburgh EH7 5HD (GB).

(74) Agents: McCALLUM, William, Potter et al.; Cruikshank & Fairweather, 19 Royal Exchange Square, Glasgow G1 3AE (GB).

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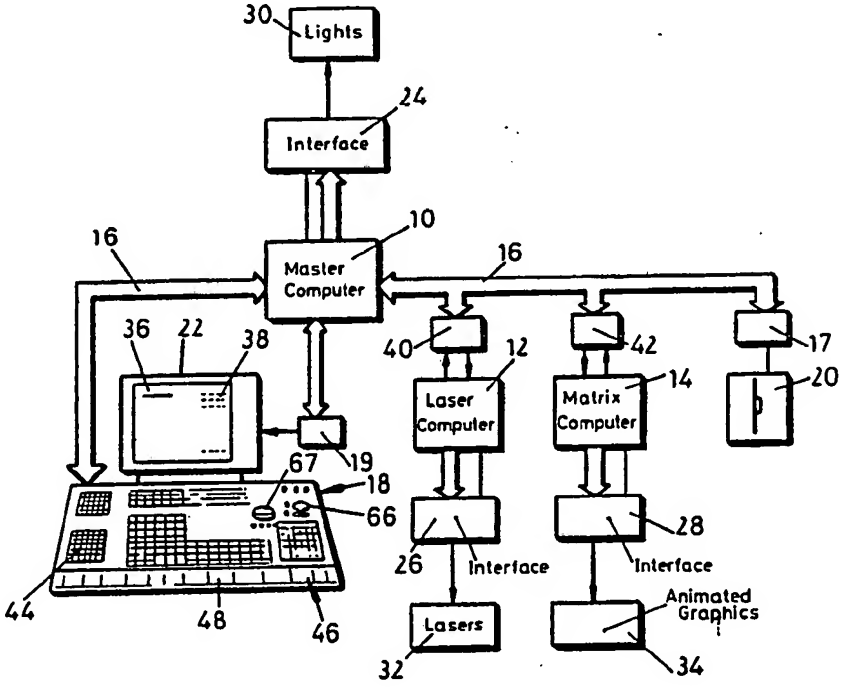

(57) Abstract

An electrical control system for controlling a plurality of devices (30) comprises a computer based control unit including at least one computer (10) coupled to an interface (30) and to the plurality of devices (30) which may be lighting elements. A keyboard (18) is connected to computer (10) together with a VDU (22) to enable an operator to select and view a menu display (36, 38) of programs held in a disc drive unit (20) for controlling the devices (30).

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PROGRAMMABLE CONTROL SYSTEM

The present invention relates to a control system, particularly, but not exclusively, to a lighting control system for controlling a plurality of lights and other devices in a common environment.

In environments such as discotheques and night clubs, lighting is available from a plurality of sources such a lasers, flashing lights, dimmers, animated graphics and the like. At present, separate controllers are available for individual devices such as dimmers, switch devices, lasers, robots and other mechanically adjustable device and graphic displays and moving messages.

With some existing systems this can mean that the controllers are disposed in separate panels and as many as ten control panels can be required to provide satisfactory control of the lighting elements. This is ergonomically difficult for a single person to operate and because the control panels are separate individual interfaces are required for each element and this can be difficult and time consuming to set up. The complexity of such an existing system is such that control is inadequate and limits the variety and flexibility of lighting effects that it would be expected to be achieved from such a variety of lighting devices.

With other types of existing systems a separate controller is connected to the separate controllers of each individual device and although this system permits some improvement it is inflexible and restricts the number and variety of lighting effects available with the aforementioned system. Attempts to improve the flexibility of the controller result in complexity and ergonomic problems.

An object of the present invention is to provide an improved lighting control system which obviates or mitigates the disadvantages associated with the

aforementioned existing arrangements.

This is achieved by providing a programmable control system including a single keyboard operated unit, which is interfaced to all the electrically controlled elements to permit a single person to readily control the selection and variety of sequences to be applied to the elements using the keyboard.

In a preferred arrangement, this is achieved by interfacing a custom designed keyboard with a microprocessor controlled visual display unit (VDU). The microcomputer is coupled via an interface to lighting control elements such as lasers, dimmers and flashing lights. A plurality of lighting control programs are stored in a memory associated with the microcomputer and these programs can be called up by the operator using the keyboard so that the existing program currently controlling a preselected lighting sequence is displayed on the screen and a menu or list is presented on the screen of available remaining lighting programs for future selection by the operator.

The programs can be readily updated by using an external memory such as a disk which can be loaded with new programs to provide further variety and control of lighting sequences. Customised interfaces permit control of lasers, dimmers and lights as well as other lighting elements.

In the arrangement an IBM P.C. (or compatible) is used as a host computer and disk-based software can be upgraded and stored in a random access memory (RAM) for longer term reliability to increase speed and cost.

Three such computers are combined in a unitary arrangement and controlled by the keyboard to permit a flexible control arrangement to control a master, a laser and a matrix control system. Each computer has its own operating system with a bi-directional RS232 data communications bus linking the computers together.

A wide range of software defined assignable controls are incorporated into the system allowing fast access for controlling different devices with the same control. This permits additional devices to be added at a later date with control LEDs according to user preference. Such additional devices are a joystick for controlling robots and/or a laser or the input to a matrix display for moving images and an encoder for varying the speed of the display. A touch panel can also be incorporated and this can be assigned to any function or combination of functions from switching a single motor to initiating a complete system blackout.

Accordingly, in one aspect of the present invention there is provided an electrical control system for controlling a plurality of devices, said system comprising a computer based control unit coupled to an interface which, in turn, is adapted to be coupled to a plurality of devices, said computer based control unit having a keyboard associated therewith, said keyboard being operable by a user to select a program from a predetermined list of programs and to control the operation of the devices in accordance with the selected program.

Preferably also, the electrical control system includes a visual display unit (VDU) for displaying the selected program currently controlling the devices and for displaying a list of alternative programs which can be selected by the operator at a future time.

Preferably also, the programs can be stored in an external disk or in a random access memory (RAM) coupled to the computer.

Preferably also, the electrical control system is a lighting control system for use in lighting and audio displays involving control of lights, dimmers, lasers and the like.

Preferably also, a plurality of additional devices

are coupled to the system to permit the control of apparatus other than lights, for example, a robot or an animated graphic system.

Preferably also, the computer based control unit is provided by three personal computers (P.C.s) coupled together on a bi-directional data bus. The computer based control unit having a disk drive associated therewith.

Preferably also, the keyboard contains keys which are assignable to the specific functions required by the control system to permit the operator to operate all elements of each plurality of devices connected to the control system from said keyboard.

According to a further aspect of the present invention there is provided a method for controlling a plurality of devices coupled to an electrical control system, said method comprising the steps of:

entering a control command through a keyboard associated with a computer based electrical control system;

selecting a device control program from a store of such programs in accordance with said input information, and

actuating said devices coupled to said electrical control system to operate in accordance with the control information within said program.

Preferably, said method includes the steps of displaying to the user an identification of the program selected which is presently controlling the electrical control system, and displaying to the user a list of alternative programs in said store which the user can select at a future time.

These and other aspects of the present invention will become apparent from the following description when taken in combination with the accompanying drawings in which:-

Fig. 1 is a schematic diagram of an embodiment of a

lighting control system in accordance with an aspect of the present invention;

Fig. 2 is a detailed view of the keyboard layout of the keyboard shown in Fig. 1;

Figs. 3, 4 and 5 are schematic diagrams of the control layout of each of the computers used to control the master, laser and matrix control systems associated with the apparatus and keyboard shown in Fig. 1 and Fig. 2.

Reference is first made to Fig. 1 of the drawings which is a schematic overall block diagram of an embodiment of a lighting control system. The system is based on three computers, a master computer 10 for controlling lights, dimmers and the like, a laser computer 12 for controlling lasers, and a matrix computer 14 controls animated graphics and moving displays. The computers 10,12 and 14 are coupled via an IBM Expansion bus 16 to each other and to a custom built keyboard 18. The master computer is also coupled via the bus 16 and adapters 17,19 to a disk drive 20 and to a VDU 22 respectively in accordance with known techniques. Each computer 10,12 and 14 is respectively connected to a device interface 24,26,28 which interfaces between the computer control system and the devices to be driven by the lighting control system, such as lights 30, lasers 32, and animated graphics 34. The disk drive 20, or a Random Access Memory (RAM) in the master computer may contain programs for controlling various lighting sequences using various combinations of the aforementioned devices coupled to the interfaces as will be later described.

In general, the operator selects, according to a desired key code on the keyboard, a program stored in the disk or RAM to control the devices in a first lighting or operating arrangement. The program is selected from a list of programs stored in the disk or RAM and passed, by

the computer, through the interface 24 to control the devices. Simultaneously, the selected lighting sequence program 36 is displayed on the VDU 22 together with a list or menu 38 of other available programs stored in the RAM so that the operator can select, at a later time, other programs from the list for controlling different sequences or lighting arrangements as will be later described in detail.

The master computer 10 has a central processing unit based on a IBM P.C. (or compatible type computer) which acts as the host computer. In fact, all three computers 10,12 and 14 are used in the present system for the master, laser and matrix control systems. The IBM P.C. or compatible type computer has been selected because it is reliable, relatively inexpensive and contains 640K memory and run at 4.77 megahertz. The use of disk based software permits easy upgrading but once software design has been proved it is possible to install the software in a RAM for longer term reliability to increase speed and cost. The latter requirements are really only applicable to the laser control system because both the master and matrix control systems require removable mass storage.

Each P.C. computer contains its own operating system and is coupled to the bidirectional RS232 communications bus 16 via 1/0 Serial Parts 40,42 being used to link the computers 10,12 and 14 together.

Separate computers have been used to facilitate reliability so that in the event of the master computer failing the laser or matrix computers can be put into an "auto-program" mode which can still provide useful effects. The system is also flexible because the matrix and laser controllers are easily modified to operate as stand alone controllers with their own simplified keyboard. The system is readily expandable, for example, if a more sophisticated matrix controller is developed it can readily be integrated with existing master

controllers with minor control software modifications required in the master. In addition, separate computers are preferred because they generally have more capacity than a single computer and permit more flexible control of the matrix animated graphic and laser displays which require considerable amount of memory for prepared data. In the the present case, the whole system is written in a high level language to facilitate control.

Control of all three computers is effected using the keyboard 18 which contains a plurality of keys 44 arranged in various groups on the keyboard as can be seen in Fig. 2. In addition, at the front of the keyboard there is a foil strip 46 containing thirty two foil rectangles 48 running along the front of the keyboard as best seen in Fig. 1. The foil strip is a touch panel which can be used by the operator as a switch to control the flashing of lights etc., as will be later described.

Reference is now made to Fig. 3 of the drawings which is a schematic block diagram of layout of the master computer 10. The master computer 10 is based on the IBM P.C. The master computer 10 uses a system of continual refresh because most devices require continual modification, for example, robots must be taken through every step of a sweep. The IBM P.C. transfers data 50 under a DMA (Direct Memory Access) control 51 to the interface 24 in the form of a robot serial converter/formatter 52 which forwards the serial output to control robots coupled thereto. The robots have inbuilt serial to parallel circuitry. The data is transferred directly from the computer memory (not shown in the interest of clarity) which permits the main process to proceed independently of output timing considerations at a much reduced processor overhead.

Data is also connected to a general serial converter which sends out serial data to various devices such as lights 30 and to the keyboard LED display driver 57 under

control of a further DMA control channel 56. An audio trigger input 63 can receive audio input data via a 4 band filter (base, treble, middle etc.) and trigger (not shown) and the data is fed to a VIA (Versatile Interface Adaptor) 65 to give sound to light control.

The keys 44 of the keyboard are coupled to keyboard scanners 60 and this information is multiplexed by a multiplexer 62 and fed through the VIA (Versatile Interface Adapter) 65 to processor 46 to indicate to the processor which key combinations have been selected. In addition, various peripherals such as joystick 66, and encoder 67 can be fed to the IBM P.C. 10 via analogue to digital converter 68 and encoder condition/count unit 69 respectively. The touch panel detector 40, joy stick 66, encoder 67 and keyboard scanners 60 as well as the LED display drivers 57 are all contained within the keyboard I8 shown in Fig. 1.

The master computer 10 uses interrupt driven initiation of DMA transfers, and sub-sequencers may be used with the interrupt to avoid minor hiccups visible during more complex operations.

Reference is now made to Fig. 4 of the drawings which is a schematic block diagram of the laser control system based on an IBM P.C. 12 and interface 26. Direct memory access (DMA) driven digital to analogue converters 82 are used for high speed pattern generation, which requires up to 200 kilobytes per second, and an interrupt driven output control 84 is connected to low speed modulation and position digital to analogue converters (DAC's) 86 which are in turn coupled to the scanners of lasers 32. The output is a voltage in the range -6v to +6v to control laser movement. Although only one channel is shown in Fig. 4 it will be appreciated that this arrangement is repeated for other channels. The laser system includes a "watchdog" fail safe hardware timer 88 which must be re-set by software to keep the laser

shutter open. The timer control data is passed from the IBM P.C. 12 through a VIA 90 to a sundry laser control or shutter grate to parallel switches associated with the laser which can be switched in accordance with existing know-how (e.g. using a 3-bit part) to create different patterns.

Reference is now made to Fig. 5 of the drawings which is a schematic diagram of the matrix lighting control system layout. This is based on the IBM P.C. host computer 14 which uses a 500 kilobit per second serial link 92 to provide multiplexed full colour operation at up to 50 frames per second for fast graphic animation effects. Output is achieved with a direct memory access control channel 94 to a serial port. The output is fed to a serial to parallel converter 92 so that the animation effects are displayed on a lamp matrix (not shown).

A lamp driver control circuit is provided by a VIA 96 coupled to a pre-heat control unit 97 under the control of an I/O control line 98. Timer 99 controls DMA triggering and interrupts as in the laser computer 12. This control sequence is designed to provide a pre-heat system to allow use of sensibly rated incandenstant lamps (2 watts). The unit 97 permits control of the multiplexing of 4 colours, red, green, blue and white. The lamp drivers use an eight-way Darlington IC taking advantage of the low cost of such devices. This avoids 8 to 10 times current surges associated with the switching on of the cold lamp. This has been achieved by using protection diodes built into the Darlington IC and drawing a pulse of current through each lamp every 20 milliseconds. This current pulse is sunk via a common terminal on the Darlington IC by an external transistor with current limiting so that the cold current is limited to a safe peak value for the darlington IC diodes. The pulse is detected and filtered to give a long time delay

before enabling the gates controlling the lamps to respond to animation data.

This system avoids the assembly costs and heat generation associated with individual pre-heat diodes/resistors or thermistors. If no pre-heating is used then grossly overrated transistors are required and the power supply surges are enormous if the display is flashed. The average rating of the display is 8 kilowatts but surges could be as much as 64 kVA without pre-heat placing considerable strain on power supply components. With the present arrangement of pre-heat control, surges are limited to around 16 kVA under most conditions. The receivers incorporate hardware monitoring of the pre-heat pulse and disabling the input to the Darlington IC during power-on, reconnection of data links or if the pulse is not present for any reason.

A spectrum analyser 102 associated with the matrix computer is coupled under direct memory access (DMA) control to the IBM P.C. 10 consists of; 30 double-tuned switching capacitor filters to provide one third octave filtering, a logging amplifier to give decimal scaling; a multiplexer, and an analogue to digital control. Data 104 is read in from the processor using direct memory access 105 to permit fast and constant multiplexing around 50 complete scans per second. This is processed by the computer after each scan to provide a real-time bar-graph display and is also used to act as a trigger for the audio trigger input 63 connected to the VIA 67 in Fig. 3. The 4 bands can be increased to about 30 bands to provide a greater variety of audio inputs and hence sound to light control. There is also a VCA on the audio input 106 for automatic level adjustment.

It will also be appreciated that with the aforementioned system extra devices may be added at a later time or the controls customised to user preference. Such extra devices may be the joystick 66

for controlling robots, a laser and an input to a matrix display for controlling moving images. This can permit control in the velocity or the position mode, as required and can also be used to adjust the size of laser patterns. The touch panel 48, which can be assigned to any function from switching a single motor to initiating a complete system blackout, and an encoder for "analogue" adjustment for speed levels etc., can also be incorporated. A group of 16 select switches can be used in conjunction with a numeric keypad to provide easy selection from menus and furthermore, additional numeric and "qwerty" keypads can be used.

Advantages of the lighting control system hereinbefore described are that a plurality of complex control functions for a lighting system having many different types of lighting elements and other devices can be controlled from a single control panel with a programming facility. This provides the benefit of user programming procedures being rationalised and in a common format because individual controllers all have different procedures, leading to confusion. All devices can be programed to operate in a synchronised fashion and a single operation can, for example, cut all general lighting and switch on the laser; or allow tracking of the laser to a graphics image on the matrix display for highly effective light shows. The use of a single control system permits all pre-sets to be named and clearly displayed on the display unit to provide menus or lists of the available selection avoiding confusion over numbered entries. The system also permits all data relating to the entire system to be kept on a disk for security, allowing time to be spent on creating a show with minimal risk of loss in contrast with individual devices which generally have no disk so that although some have battery backed memory, in the event of failure this is not transferrable to a replacement system. Also

each computer is self-contained and has a front panel selectable "back-up" switch which can put the laser or matrix computers into an "auto-program" mode so that in the event of the master computer failing the Laser and Matrix computers can operate to provide useful effects.

In addition, the system has a large selection of immediately accessible presets without having to go through menus, that is 64 keys and eight groups of 8 may be assigned to any mixed preset types. There is also a desk facility where the current mix of selections of banks can be stored and recalled allowing for example, four of the eight banks to be switched immediately from 32 laser presets to a mixture of matrix and robot types. This creates a "virtual" control panel for a vast selection of options which are quickly and easily selectable.

There is also a facility to permit immediate and temporary modification of existing presets where this is useful, for example, colours, speeds etc. This avoids multiple presets in similar settings and allows the user to perform actions spontaneously without affecting the stored presets. The LED indicators provide a clear confirmation of selection in a darkened environment and wherever possible "default" selection is assumed if a key stroke is skipped, so for example if the robot colour is changed and no entry is made for the selection of the robots 1 to 16 it assumes that the last choice is still valid.

A set-up preset type is provided which contains a combination of the actual device presets, the laser, matrix etc. and allows several devices to be started together in a convenient fashion. Furthermore, switch-on codes are entered which restrict access to one of three levels although this is extendable as required. For example, one level could be code for a user without entry allowed to any programming function avoiding corruption

of carefully prepared light shows and disabling the laser for safety reasons; another level could be a code for a user + laser + program which permits this user full access to all the facilities. Such codes can be revealed to selective authorised user and installers and may be changed as required.

CLAIMS

1. An electrical control system for controlling a plurality of devices, said system comprising a computer based control unit 10 coupled to an interface 30 which, in turn, is adapted to be coupled to a plurality of devices 30, said computer based control unit 10 having a keyboard 18 associated therewith, said keyboard 18 being operable by a user to select a program from a predetermined list of programs 38 and to control the operation of the devices 30 in accordance with the selected program 36.

2. An electrical control system as claimed in claim 1, wherein the electrical control system includes a visual display unit (VDU) 22 for displaying the selected program 36 currently controlling the devices 30 and for displaying a list 38 of alternative programs which can be selected by the operator at a future time.

3. An electrical control system as claimed in either preceding claim, wherein there are first, second and third pluralities of devices (30, 32, 34) and the computer based control unit comprises first, second and third computers 10, 12, 14 coupled together on a directional data bus 16 and coupled to the respective pluralities of devices 30, 32, 34 through interfaces 24, 26, 28 at least one of said pluralities of devices 30, 32, 34 comprising a plurality of lighting elements.

4. An electrical control system as claimed in any preceding claim, wherein the keyboard 18 contains keys 44 which are assignable to the specific functions required by the control system to permit the operator to operate all elements of each plurality of devices 30, 32, 34 connected to the control system from said keyboard.

5. A method for controlling a plurality of devices coupled to an electrical control system, said method comprising the steps of:

entering a control command through a keyboard

associated with a computer based electrical control system;

selecting a device control program from a store of such programs in accordance with said input information, and

actuating said devices coupled to said electrical control system to operate in accordance with the control information within said program.

6. A method as claimed in claim 5, wherein said method includes the steps of displaying to the user an identification of the program selected which is presently controlling the electrical control system, and displaying to the user a list of alternative programs in said store which the user can select at a future time.

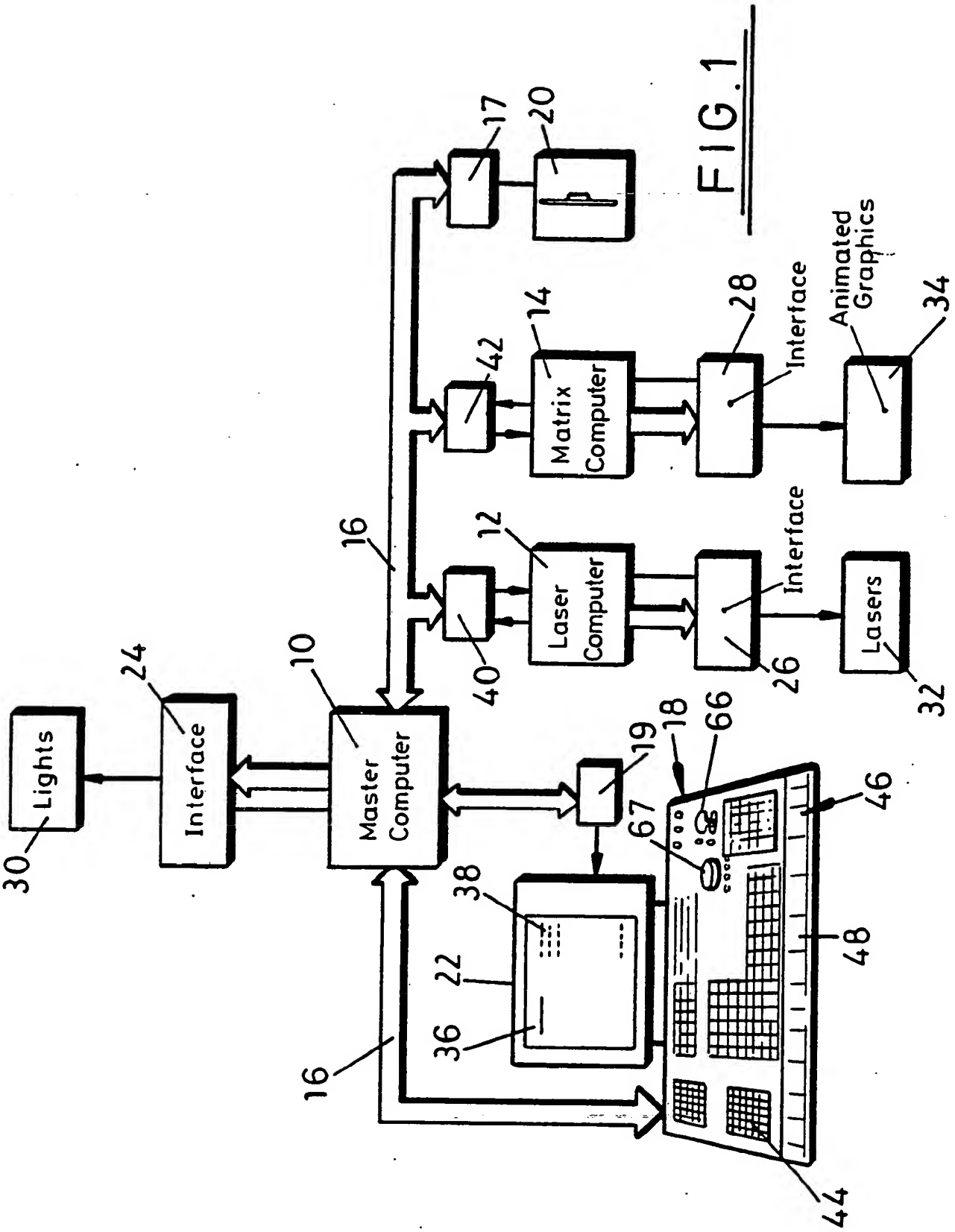
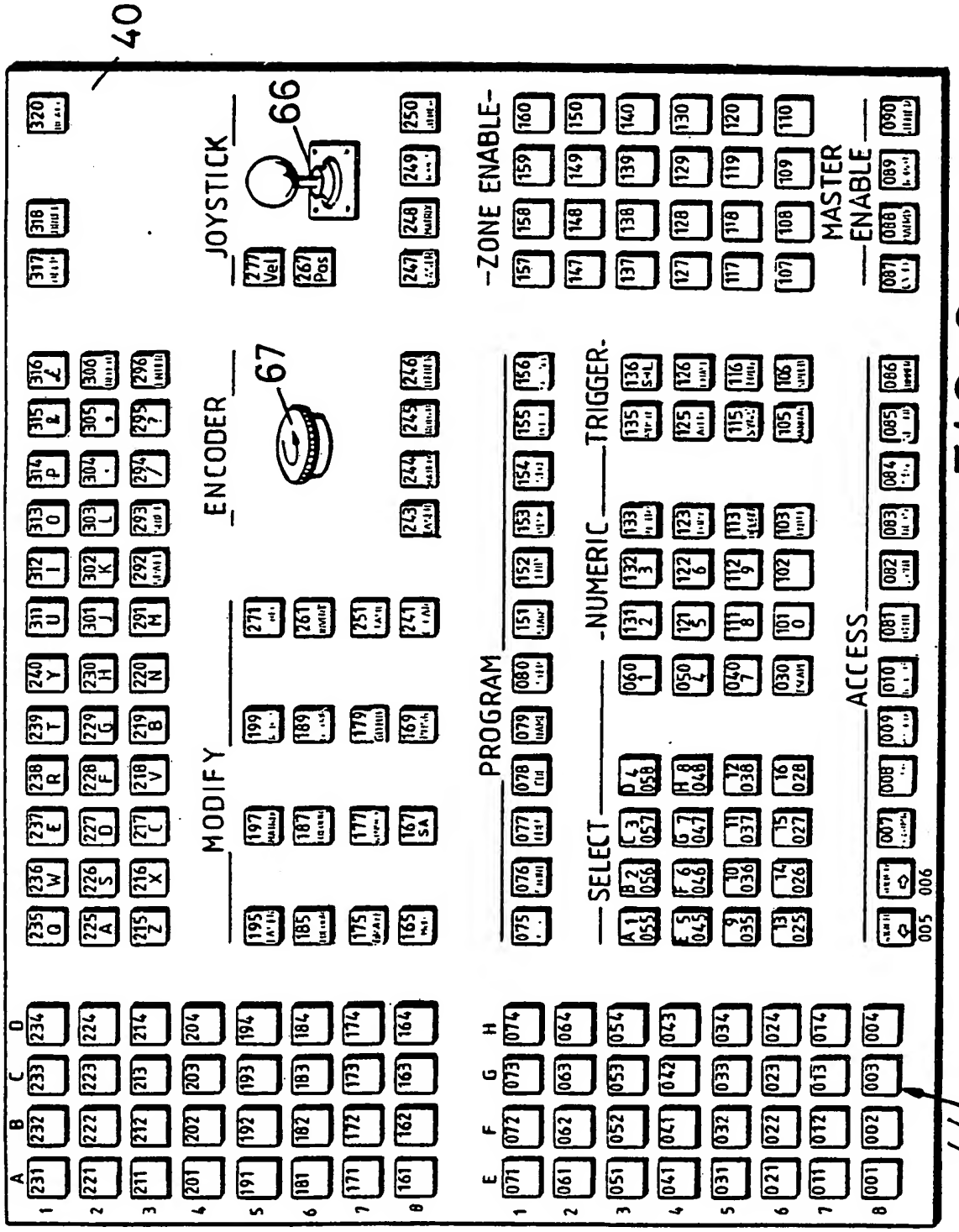

Lights
30
Interface
24
Master Computer
10
16
Matrix Computer
14
Laser Computer
12
Interface
28
Interface
26
Animated Graphics
34
Lasers
32
17
20
42
40
18
66
19
67
46
38
22
36
48
44

FIG. 1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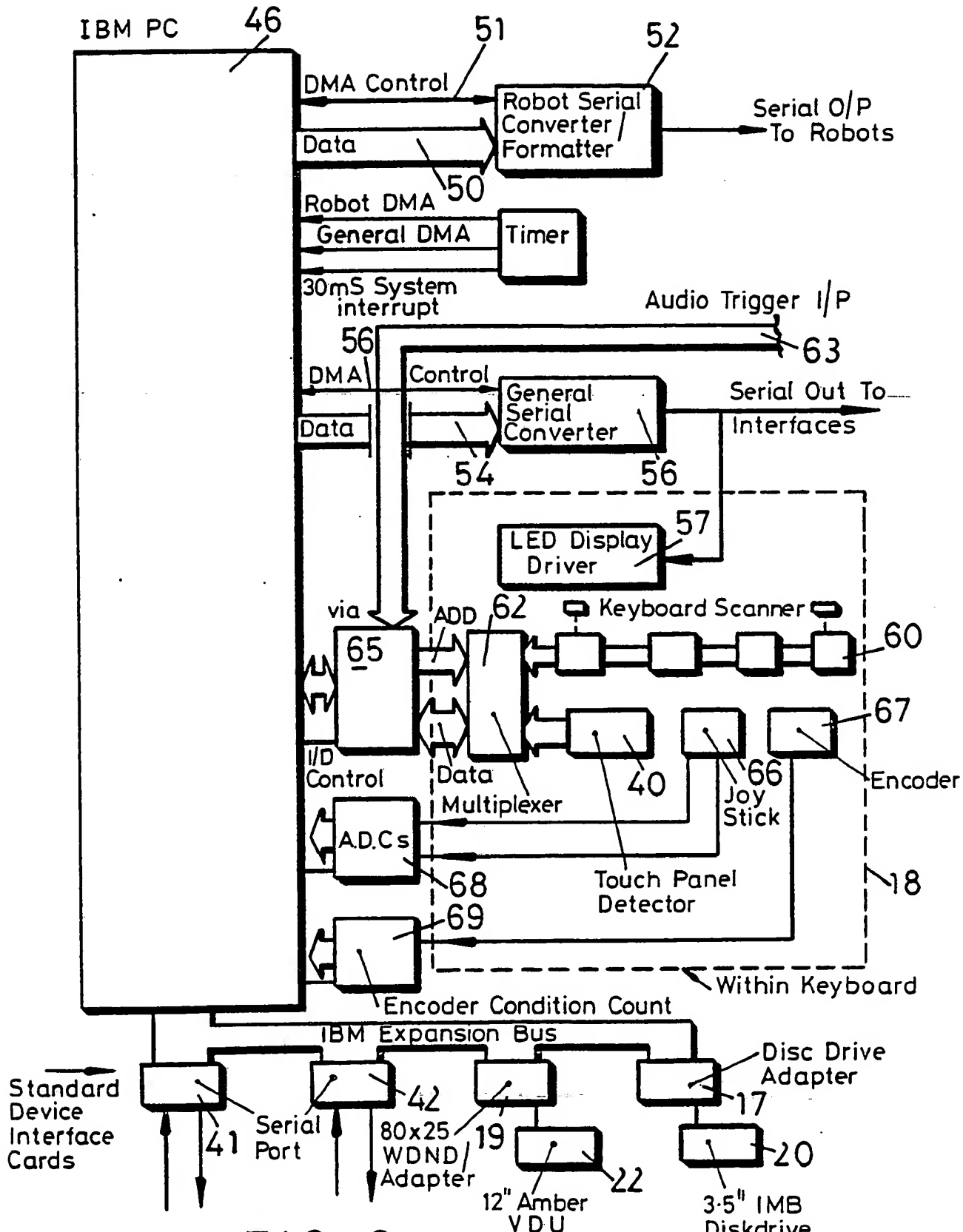
44
66
67
JOYSTICK
ENCODER
MODIFY
PROGRAM
SELECT
NUMERIC
TRIGGER
ZONE ENABLE
ACCESS
MASTER ENABLE
Vel
Pos

FIG. 2


IBM PC
46
51
52
DMA Control
Robot Serial Converter / Formatter
Serial O/P To Robots
Data
50
Robot DMA
General DMA
Timer
30mS System interrupt
Audio Trigger I/P
56
63
DMA
Control
General Serial Converter
Serial Out To Interfaces
Data
54
56
57
LED Display Driver
via
ADD
62
Keyboard Scanner
60
65
67
I/D Control
Data Multiplexer
40
66
Joy Stick
Encoder
A.D.Cs
68
Touch Panel Detector
18
69
Within Keyboard
Encoder Condition Count
IBM Expansion Bus
Disc Drive Adapter
17
Standard Device Interface Cards
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Serial Port
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80x25 WDND Adapter
19
12" Amber VDU
22
3·5" IMB Diskdrive
20

FIG. 3

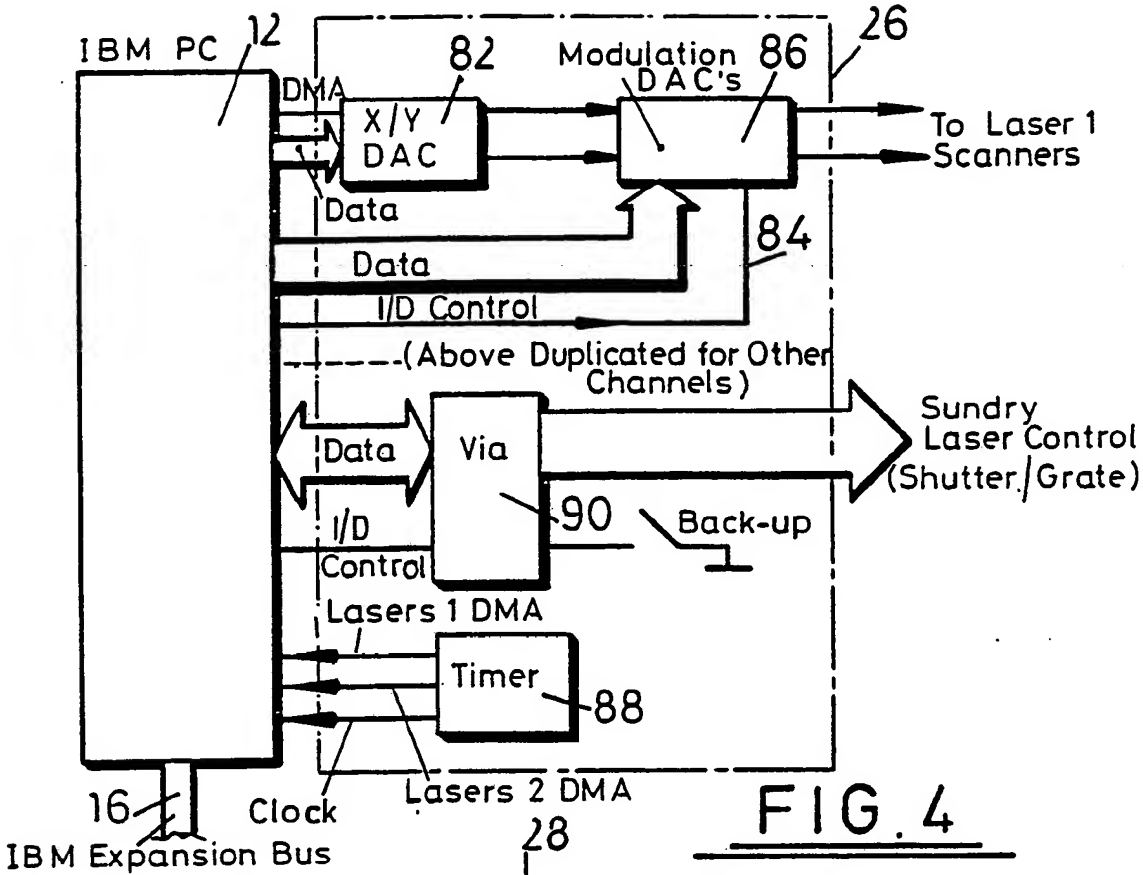
IBM PC
12
82
Modulation DAC's
86
26
DMA
X/Y DAC
To Laser 1 Scanners
Data
Data
84
I/D Control
(Above Duplicated for Other Channels)
Sundry Laser Control (Shutter/Grate)
Data
Via
I/D Control
90
Back-up
Lasers 1 DMA
Timer
88
16
Clock
Lasers 2 DMA
IBM Expansion Bus

FIG. 4

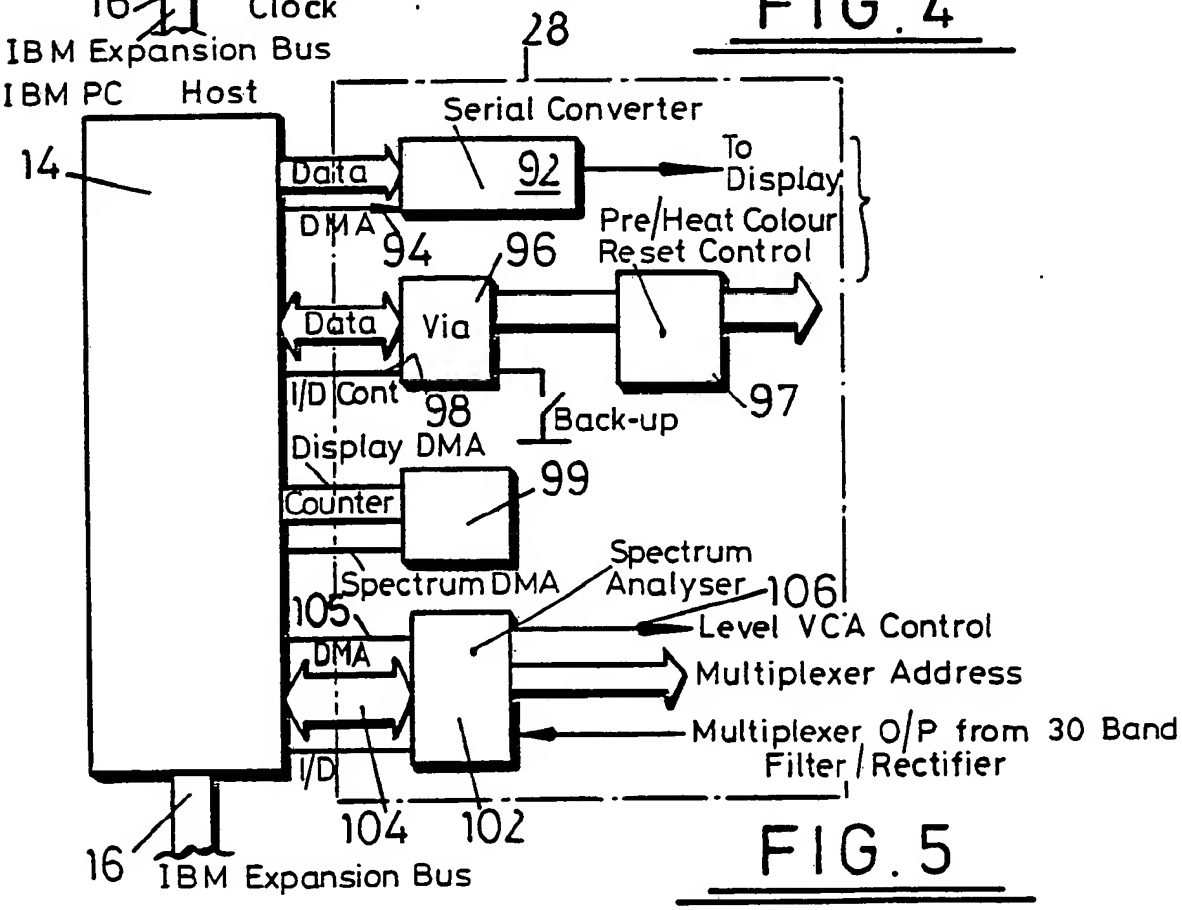
28
IBM PC Host
Serial Converter
14
Data
92
To Display
DMA
94
96
Pre/Heat Colour Reset Control
Data
Via
I/D Cont
98
Back-up
97
Display DMA
Counter
99
Spectrum Analyser
106
Spectrum DMA
105
Level VCA Control
DMA
Multiplexer Address
Multiplexer O/P from 30 Band Filter/Rectifier
I/D
104
102
16
IBM Expansion Bus

FIG. 5

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8801029 SA 25559

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/03/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3898643	05-08-75	CA-A- 1014682	26-07-77
FR-A- 2466051	27-03-81	None	
DE-A- 3446113	10-07-86	None	